SUPERPAVE IN WASHINGTON STATE

Introduction
The Superpave (**SU**perior **PER**forming Asphalt **PAVE**ments) system was developed to give highway engineers and contractors the tools they need to design asphalt pavements that will perform better under various temperature ranges and traffic loads.

Superpave was developed through the Strategic Highway Research Program (SHRP). The asphalt research program had three objectives: to investigate why some pavements perform well, while others do not; to develop tests and specifications for materials that will outperform and outlast the pavements being constructed today; and to work with highway agencies and industry to have the new specifications put to use.

What is Superpave?
The Superpave system primarily addresses two pavement distresses: permanent deformation (rutting) and low temperature cracking. The unique feature of the Superpave system is that it is a performance-based specification system – the tests and analyses have direct relationships to field performance[1].

Photo 1. Rutting

Photo 2. Low Temperature Cracking

Superpave represents an improved system for specifying asphalt binders and mineral aggregates, developing asphalt mixture design, and analyzing and establishing pavement performance prediction[1].

The Superpave system consists of three interrelated elements: asphalt binder specification; volumetric mix design and analysis system; and mix analysis tests and a performance prediction system that includes computer software, weather database, and environmental and performance models.

The **asphalt binder specification** allows for the selection of an asphalt binder to meet the low temperature (for minimizing thermal/transverse cracking), high temperature (for minimizing rutting) and the truck traffic volumes (for minimizing rutting) for a specific pavement section. This implies that different binders will be used in eastern and western Washington and on different functional classes of highways. The following map illustrates the base grade binders used in Washington State. In general, the binders on the east side of the state will contain modifiers to meet the performance grade (PG) binder grading system.

The **volumetric mix design and analysis system** allows for the selection of a sound aggregate structure to support the anticipated truck traffic and minimize the potential of rutting.

The **mix analysis test and performance prediction system** allows for a procedure to predict how a specified mix design (according to rutting and low temperature cracking) will perform in a specified climatic location under specified truck volume.

[1] Superpave Level 1 Mix Design, Superpave Series No. 2 (SP-2), Asphalt Institute.

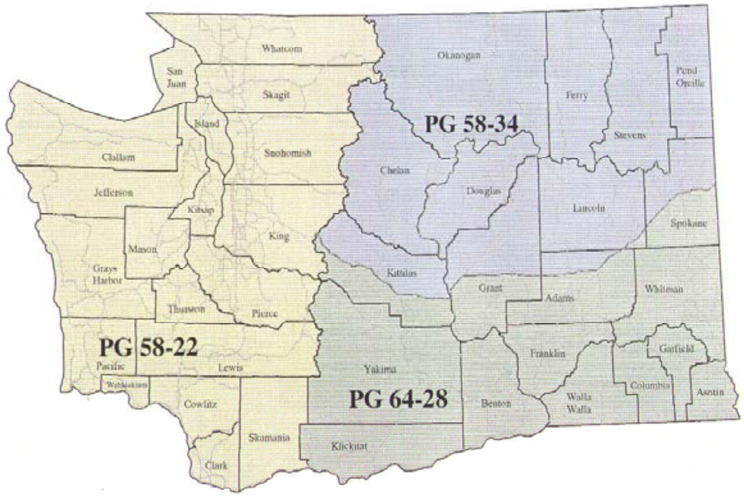

Figure 1. Performance Grade Binder Location Map

Why change the mix design procedure?
The following illustrates the benefits of the Superpave mix design procedure over the current Hveem method.

<u>**Superpave**</u>
- Considers environmental effects
- Considers traffic levels (heavy truck volumes, slow moving or stopped traffic)
- Ability to predict pavement performance

<u>**Hveem**</u>
- Developed in the 1950's
- Measures mixture stability (which is closely related to rutting potential)
- Does not consider
  - Climate
  - Traffic loading

There is not, nor will there be any local, regional or national improvements to the Hveem mix design procedure. The United States as a whole is moving towards the acceptance and implementation of the Superpave technology. Since pavement performance is dependent on material properties, it is essential to realize that the Superpave technology provides the ability to analyze mix properties and their affect on asphalt concrete pavement performance.

Performance
A total of 46 Superpave projects have been constructed from 1995 to present. On average, these projects have performed in a similar manner to the WSDOT Class A/B mixtures (Materials Lab will be developing a Superpave summary report by the end of 2001). The oldest project has been in service for five years and it is still too early to make any statements concerning improvement in pavement performance. It is anticipated that the average pavement life for Superpave designed overlays will be 15 years. This implies that the average pavement life for the east side will increase from 10.9 years to 15 years. At this time it is uncertain if the west side pavements will show as dramatic of an increase in pavement life, current average pavement life for west side pavements is 15.9 years. However, we should see a reduction in aging and rutting, which would imply an increase in pavement life.

<u>How is the average pavement life determined?</u>
The average pavement life is calculated as follows:

1. Analysis based on the Washington State Pavement Management System.
2. All roadway segments overlaid prior to 1997 are used in the analysis.
3. Determine the "due year" for each roadway segment. "Due" is defined as:
   a. Pavement structural condition (10% alligator cracking) = 40 to 60,
   b. Rutting = 1/3", or
   c. Ride (IRI) = 170 to 220 in/mile
4. Lane miles are summarized according to pavement type, functional class and Region.
5. Average pavement life is calculated using the life of each pavement segment weighted by lane miles for each group in step 4.

Cost

The following table and figure compare the average lane mile cost for ACP Class A or B versus ACP Class A or B with PG binders versus ACP Class Superpave. Selected projects for comparison were constructed between 1995 and 2001 and had asphalt tonnage greater than 10,000 tons.

Table 1. Cost Summary of ACP Class A or B, ACP Class A or B with PG Binder and ACP Class Superpave.

	ACP Class A or B				**ACP Class A or B with PG Binder**				**ACP Class Superpave**			
Region	# of Projects	Minimum ($/ln-mi)	Maximum ($/ln-mi)	Average ($/ln-mi)	# of Projects	Minimum ($/ln-mi)	Maximum ($/ln-mi)	Average ($/ln-mi)	# of Projects	Minimum ($/ln-mi)	Maximum ($/ln-mi)	Average ($/ln-mi)
Northwest	16	$ 61,732	$238,274	$141,148	14	$ 71,918	$252,955	$109,460	4	$107,671	$288,611	$172,697
Northcentral	7	$ 59,292	$256,668	$ 81,930	10	$ 68,954	$192,496	$ 95,443	6	$ 60,241	$140,134	$ 98,790
Olympic	12	$ 52,969	$203,159	$ 89,963	19	$ 61,164	$248,923	$116,363	3	$ 35,907	$195,671	$ 92,740
Southwest	7	$ 51,472	$110,584	$ 76,731	5	$ 41,596	$244,174	$122,761	3	$ 69,070	$188,928	$108,248
Southcentral	14	$ 73,276	$256,838	$133,972	14	$ 55,068	$191,448	$ 89,500	11	$ 57,761	$279,640	$115,714
Eastern	8	$ 59,739	$128,121	$ 96,512	8	$ 54,044	$244,982	$102,799	11	$ 54,632	$275,638	$ 98,005

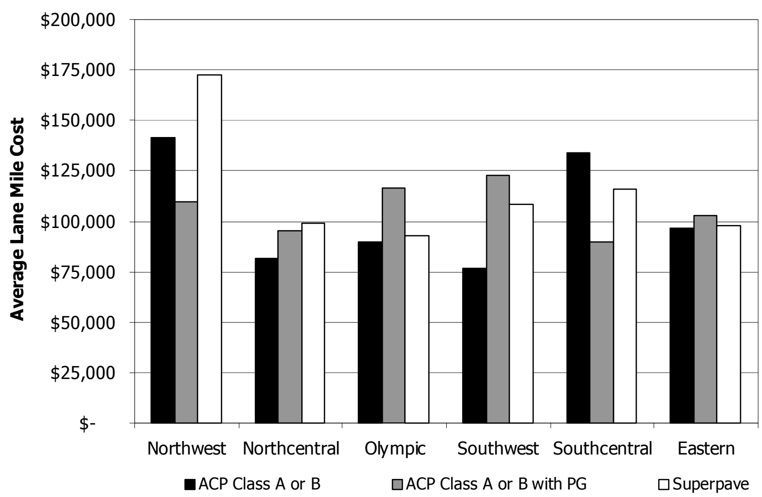

Figure 2. Summary of ACP Costs (lane-mile)

Implementation Plan

The Materials Laboratory has established a target implementation schedule for Superpave. The success of this schedule is a function of our partnerships with the Regions and APAW, obtaining the additional funding for equipment purchase, and an increase in construction staffing levels to support the required testing. Implementation of the Superpave mix design procedure is critical to keep Washington state in-step with current on-going research efforts with asphalt concrete pavements.

1999 – full implementation of PG binders
2001 – small test volumetrics QC/QA (3 projects selected)
2002 – larger test of volumetric QC/QA (5 projects eastern, 5 projects western WA)
2003 – All Superpave projects use volumetric QC/QA
2004 – All projects use Superpave and all projects use volumetric QC/QA

The following table lists the Superpave projects completed to date.

Cont #	SR	Year	Region	Project Title	Class Mix	PG Grade
4694	291	1996	E	Lowell Avenue to Nine Mile	12.5 mm	58-34
5124	17	1997	SC	SR 395 to Basin City Road	12.5 mm	64-28
5132	291	1997	E	Division Street to Lowell Avenue	12.5 mm	70-34
5184	101	1997	SW	Greenhead Slough to Wildlife Boat Launch	12.5 mm	58-22
5192	99	1997	O	MP 0.00 to King County Line	12.5 mm	64-22
5290	17	1998	NC	SR 26 to Lind Coulee	12.5 mm	64-28
5295	99	1998	NW	Thomas Street to 152nd Street	12.5 mm	70-22
5338	395	1998	E	Franklin County Line to Janz Road	12.5 mm	64-28
5364	14	1998	SW	Vancouver City Limits to NE 164th Avenue	12.5 mm	58-22
5367	2	1998	E	Reardan to Espanola	12.5 mm	58-34
5373	82	1998	SC	Valley Mall Boulevard To Yakima River	19.0 mm	70-28
5381	512	1998	O	Railroad Crossing to Canyon Road	12.5 mm	58-22
5408	240	1998	SC	SR 182 to SR 395	12.5 mm	64-28
5497	2	1999	E	Davenport to Reardan	12.5 mm	58-34
5544	2	1999	E	Vicinity Four Lanes to SR 211	12.5 mm	64-34
5581	82	1999	SC	West Prosser Interchange to Oregon State Line	19.0 mm	70-28
5626	524	1999	NW	64th Avenue West Vicinity to 40th Avenue West Vicinity	SMA	64-22
5627	17	1999	NC	Lind Coulee Bridge to Vicinity SR 90	19.0 mm	64-28
5636	20	1999	E	Degrief Road to Vicinity Spruce Canyon Road	19.0 mm	58-34
5645	99	1999	NW	138th Street to West Marginal Way	12.5 mm	64-22
5654	18	1999	NW	Issaquah/Hobart Road to SR 90	12.5 mm	64-22
5659	395	1999	E	Lind to I-90	12.5 mm	70-28
5663	82	1999	SC	Naches River Bridge to Valley Mall Blvd.	19.0 mm	70-28
5666	12	1999	O	Cedar Creek to Vicinity Moon Road	12.5 mm	58-22
5677	12	2000	SW	Surrey Creek Bridge to Lake Creek Vicinity	12.5 mm	64-28
5779	90	2000	NC	Vantage Bridge to Burke	19.0 mm	64-28
5803	27	2000	E	Fallon to Palouse	19.0 mm	64-28
5814	167	2000	NW	8th Street to 15th Street SW	19.0 mm	64-22
5848	395	2000	SC	East Elm Road to SR 17	19.0 mm	70-28
5851	22	2000	SC	McDonald Road to SR 97	12.5 mm	64-28
5858	195	2000	E	Plaza to Vicinity Cornwall Road	12.5 mm	64-28
5868	395	2000	SC	Kennewick Ave Intersection to SR 182	19.0 mm	76-28
5882	90	2000	E	Tokio Weigh Station	SMA	64-34
5906	90	2000	SC	Gold Creek to Easton	12.5 mm	64-34
5956	97	2001	NC	Okanogan to Riverside	1/2"	58-34
5977	240	2001	SC	Stevens Drive to SR-182	19.0 mm	64-28
5995	26	2001	NC	E SW Rd to Adams Co Line	1/2"	64-28
6018	97	2001	NC	Daroga State Park to Twin W Orchards	12.5 mm	58-34
6020	508	2001	O	SR-5 to SR-7	?	?
6059	395	2001	SC	SR-17 to Adams Co Line	3/4" mm	70-28
6061	90	2001	SC	W Ellensburg to S Ellensburg	1/2"	70-28
6104	90	2001	NW	Mercer Slough to 128th Ave SE	19.0 mm	64-22